difficult to capture owls during this period, because they often flew from the burrow upon our approach with traps, rather than fleeing into the burrow, as did many younger owls. In addition, young owls after fledging used dense sagebrush habitat much more frequently than did owls prior to this time. This indicates that, although dense sagebrush habitat is rarely used by nesting owls, it may offer some characteristics that are desirable for dispersing owls and those preparing for fall migration. For example, this habitat may provide more cover from predators, more perches from which to scan for predators or potential prey, or more shade during the late summer when temperatures reach extremes.

Dispersal. — Young owls dispersed (made permanent movements of > 300 m from the natal burrow) beginning in July and when the juveniles were an average of 88 days old. These movements occurred throughout the period of late-July through late-September and early-October. Thus, if young burrowing owls are observed during this time period, one could not be certain that they were in the immediate vicinity of their natal burrows. That is, owls captured during this time period could not be considered *Locals* and, in the notation of the U.S. Fish and Wildlife Service's Bird Banding Laboratory, would best be aged as *Hatching Year*, with no connotation about them being raised in a particular study area. Haug (1985) suggested that young burrowing owls in Saskatchewan begin dispersing from breeding areas in late-July and early August, as the young owls become less dependent on parents. Although Haug's (1985) study did not monitor young with radio-telemetry, and therefore could not follow young as closely as we could, this suggests that similar behavior is observed in Canadian populations of burrowing owls.

We found that dispersing burrowing owls moved an average of 1.4 km from their natal burrows, ranging from around 200 m to over 3.6 km. This average value should be viewed with caution, however, because it comes largely from shorter distance dispersers (contact with owls that moved longer distances was occasionally lost). For example, we knew that juveniles from one family dispersed greater than 3 km because we did not locate them after repeated searches within this distance. We subsequently calculated their dispersal distance as > 3000 m (3 km), and included this value in our calculation of the average. Thus, the average dispersal distance would likely increase if the distances of birds moving farther were accurately known and included. Nonetheless, our data suggest that, on average, young burrowing owls do not move very far (usually less than 3 km) from their natal burrows before migrating in the fall. Our analyses also suggest that dispersal movements are not oriented in any particular direction; that is, dispersal movements were random in their orientation. This suggests that, despite the fact that they would be migrating south to winter for instance, owls did not consistently disperse in a southerly direction before initiating migratory movements.

Because our study was limited to one breeding season (1994), we do not have any information on how faithful breeding adults and their offspring are to breeding areas; that is, our study could not determine the degree to which burrowing owls in southwestern Idaho exhibit site fidelity. Additional field work during the spring

and summer of 1995 would be required to assess the proportion of returning adults, and to determine if and how many young raised on the area in 1994 return to breed in 1995. Some site fidelity has been reported for adult burrowing owls in other portions of their range. In southern Saskatchewan, for instance, only 26% of re-encountered adults moved to different pastures, suggesting that many breeding adults returned to the same pasture to nest in subsequent years (Haug et al. 1993). In nonmigratory populations (e.g., Florida), as many as 68% of surviving adults remain faithful to nesting areas between years (Haug et al. 1993). Information on the breeding sites of returning juveniles is essentially lacking from the published literature. However, determining how faithful burrowing owls are to nesting sites has obvious wildlife and land management implications. That is, without this information, it would not be possible to adequately assess impacts to breeding sites that occur during the time period when owls are on their wintering areas. If owls show no fidelity, activities that disturb habitat in the immediate vicinity of burrows would have fewer negative impacts on the owls, because the owls would be unlikely to return to these sites anyway. However, if owls show strong fidelity to breeding sites, then negative impacts to these sites during winter could potentially be limited to avoid affecting this sensitive species.

The food supplementation experiment suggests that food availability may be one proximate factor that influences the dispersal movements of young owls, and this information may potentially have wildlife management implications as well. Although we only supplemented the diets of three young owls in two family groups, the data suggest that an adequate supply of food may cause young burrowing owls to delay dispersal movements. For example, we observed a large difference in the mean age at dispersal between the fed and unfed juveniles, with provisioned young dispersing an average of 48 days later. These results indicate that supplementally fed juveniles will disperse later than those which are not fed and that there may be no need to disperse when juveniles have easy access to a reliable food source. Such information could potentially be important if one were interested in manipulating the movements of burrowing owls. That is, one might be able to cause young owls to remain in their natal areas for an additional 6 weeks by providing a reliable food source (e.g., mice, chicks, etc.). By keeping young owls in the vicinity of natal areas, one could improve the chances that they do not move into areas where they would experience some known negative impact, for example. While it is difficult to imagine such a scenario presently, our results suggest that manipulating the availability of food during the post-fledging period is a tool that could be used by land managers to influence the movements and distributions of these and perhaps other birds.

Mortality Factors. — Six of the nests we monitored (43%) failed to fledge any young, and at least two of these failures were likely a result of predation by mammalian predators. We also documented several cases of mortality during both the pre-fledging and post-fledging periods. Important mortality factors during these periods included collisions with automobiles, shooting by humans, and predation. Although burrowing owls appear to be relatively tolerant of disturbance by humans,

and they make use of many human-altered landscapes (e.g., roads, agricultural areas, residential areas), they also suffer because of a couple of factors directly or indirectly related to human activities. For example, Konrad and Gilmer (1984) reported that 3 of 5 known deaths in their study were caused by vehicle collisions, and Haug and Oliphant (1987; cited in Haug et al. 1993) concluded that 37% of owl remains they found were attributable to automobile collisions. With increasing human pressures in the immediate vicinity of our study area (i.e., Kuna and nearby Boise), it is likely that automobile collisions will become an increasingly important factor in affecting burrowing owl populations. However, because these owls often hunt and perch along roadways, there are probably few if any options available to limit the number of road kills in this area. In addition to our study, shooting by humans as a mortality factor has also been reported by Wedgwood (1978; cited in Haug et al. 1993) and Butts (1973), and Haug et al. (1993) conclude that the severity of this problem is unknown. However, it may be larger than we realize, particularly on public lands which allow all types of hunting and shooting activities. With proper education of shooters and enforcement of existing laws, this would appear to be one area in which mortality rates could be decreased if mortality from shooting increased to the point that it became a serious impact. Finally, predation by mammalian predators occurred on several occasions resulting in nest failure. If predation by mammals increased to the point that it began to cause population declines in our study area, at least one management option is available. For example, nest predation is so severe in some Canadian populations, where burrowing owls have declined rapidly in recent years, land managers are taking actions to repel nest predators (pers. comm., Dr. Joe Schmutz, member Canadian Burrowing Owl Recovery Team, University of Saskatchewan, Saskatoon). Wire guards are placed over the entrances to burrows, allowing owls to come and go, but they are constructed in such a way that they prohibit the much larger mammalian predators from entering and eating young. A much longer study of nest success and predation combined with longer-term population monitoring would be required to determine if burrowing owls in our study area are declining because of severe predation pressures or the other mortality factors we observed.

Migration. — While burrowing owls in Florida and southern California are nonmigratory (Thomsen 1971, Millsap *in press*, cited in Haug et al. 1993), our results indicate that both young and adult owls left our study area and surrounding locations by mid-October, and some individuals left much earlier. Although there is no information on where they winter, these initial data indicate that all of the burrowing owls in our study population migrated following the breeding season. Although this is consistent with the notion that burrowing owls in southwestern Idaho are obligate migrants, additional years of study would be required to determine if there is a facultative component to burrowing owl migration. For example, our one-year study could not address the possibility that these owls may fail to migrate in some years, or that some proportion of the population may remain in some years but not others. Furthermore, Haug et al. (1993) suggest the possibility that Canadian burrowing owls migrate farther south than those banded in the United States, suggesting a "leap-frog" migration, but considerable more work is

needed in this area before we can understand the migratory patterns of burrowing owls.

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